TITIE: METHOD AND APPARATUS FOR DRY-ETCHING HALF-TONE PHASE-SHIFT FILMS, HALF-TONE PHASE-SHIFT FILMS, HALF-TONE PHASE-SHIFT PHOTOMASKS AND METHOD FOR THE PREPARATION THEREOF, AND SEMICONDUCTOR CIRCUITS AND METHOD FOR THE FABRICATION THEREOF Inventor: Takaei SASAKI et al Appln. No.: New Application Docket No.: 101136-00102

Fig. 1

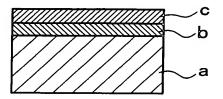


Fig. 2

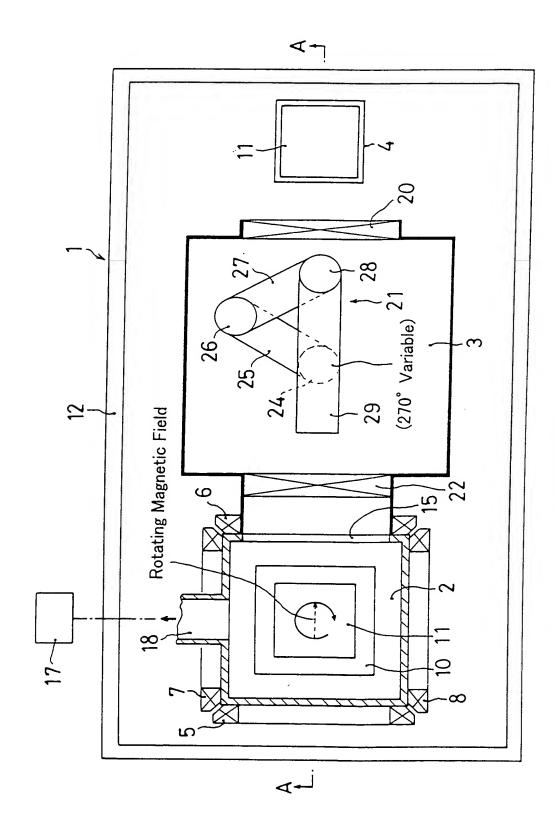
Flow	Electron Beam Patterning Process	Laser Beam Patterning Process
Receipt of Blank	·	
Exposure/Patterning	Electron Beam Patterning Device	Laser Beam Patterning Device
	Spray, Dip, Paddle Systems	
Development	Organic Solvent Development Alkali Development	Alkali Development
Post-Baking	Hot Plate Oven Convection Oven	Generally, any treatment is not required.
De-scumming	Plasma De-scumming Device	Generally, any treatment is not required.
	Wet Etching and Dry-Etching	
Removal of Resist	Solvent Pealing, Ashing	Exposure of Whole Surface/Alkali Pealing, Solvent Pealing, Ashing
Washing	Sheet-Fed Acid-Treatment, Physical Scrubbing, or the like	
To Inspection Step		

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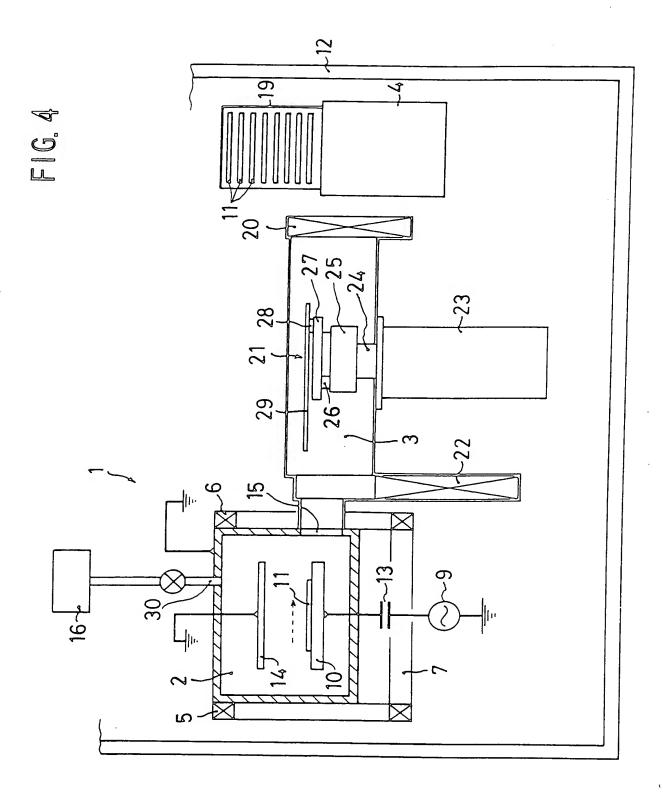
IIIIe: METHOD AND APPARATUS FOR DRY-ETCHING HALF-TONE PHASE-SHIFT FILMS, HALF-TONE PHASE-SHIFT PHOTOMASKS AND METHOD FOR THE PREPARATION THEREOF, AND SEMICONDUCTOR CIRCUITS AND METHOD FOR THE FABRICATION THEREOF Inventor: Takaei SASAKI et al

Appln. No.: New Application Docket No.: 101136-00102

F16.



Title: METHOD AND APPARATUS FOR DRY-ETCHING HALF-TONE PHASE-SHIFT FILMS, HALF-TONE PHASE-SHIFT PHOTOMASKS AND METHOD FOR THE PREPARATION THERE AND SEMICONDUCTOR CIRCUITS AND METHOD FOR THE FABRICATION THEREOF Inventor: Takaei SASAKI et al Appln. No.: New Application Docket No.: 101136-00102



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THE: METHOD AND APPARATUS FOR DRY-ETCHING HALFTONE PHASE-SHIFT FILMS, HALF-TONE PHASE-SHIFT
PHOTOMASKS AND METHOD FOR THE PREPARATION THERE
AND SEMICONDUCTOR CIRCUITS AND METHOD FOR THE
FABRICATION THEREOF
Inventor: Takaei SASAKI et al

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## Fing. 5 A

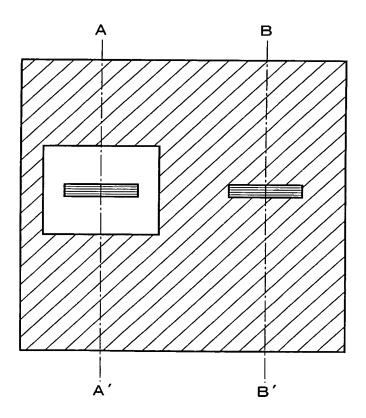
Completely Removed Pattern (Periphery of the Dimension-Evaluation Pattern)

Dimension-Evaluation Pattern (L/S, Isolated L, Isolated S)

20mm

20mm

Fing. 5B



←Dense Portion→ Coarse Portion→

THE: METHOD AND APPARATUS FOR DRY-ETCHING HALF-TONE PHASE-SHIFT FILMS, HALF-TONE PHASE-SHIFT PHOTOMASKS AND METHOD FOR THE PREPARATION THERE-AND SEMICONDUCTOR CIRCUITS AND METHOD FOR THE FABRICATION THEREOF

Inventor: Takaei SASAKI et al Appln. No.: New Application Docket No.: 101136-00102

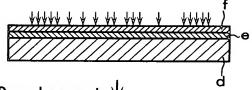
Fing. 6 A

Fing. 6 B

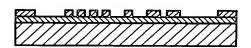
Test Pattern on Dense Portion(A-A')

Test Pattern on Coarse Portion(B-B')

(a) EB Patterning



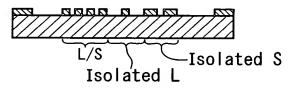
(b) Development \<sup>\psi</sup>



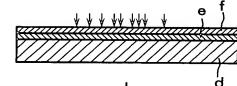
(c) Etching



(d) Removal of Resist

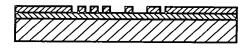


(a) EB Patterning



(b) Development 

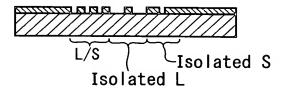
√



(c) Etching



(d) Removal of Resist



0.06

0.04

Dimensional Difference (  $\mu$  m)

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0.02

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ITILE: METHOD AND APPARATUS FOR DRY-ETCHING HALF-TONE PHASE-SHIFT FILMS, HALF-TONE PHASE-SHIFT PHOTOMASKS AND METHOD FOR THE PREPARATION THEREOF, AND SEMICONDUCTOR CIRCUITS AND METHOD FOR THE FABRICATION THEREOF

Inventor: Takaei SASAKI et al Appln. No.: New Application Docket No.: 101136-00102

Fig. 8

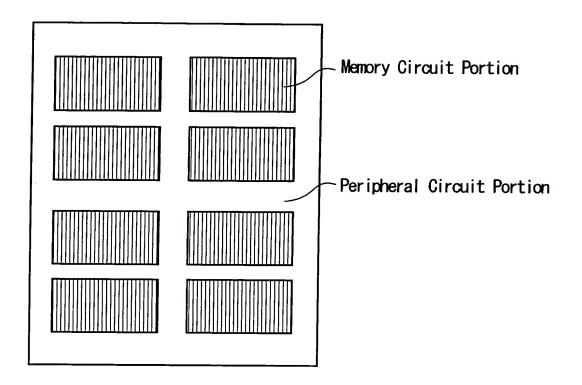
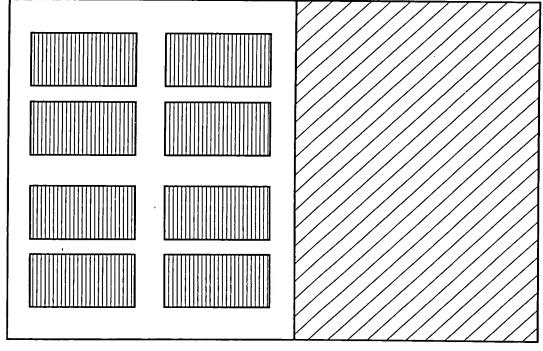


Fig. 9



Memory Circuit Portion

Logic Circuit Portion